

Electric Sail Propulsion to Enable Heliopause and Beyond Scientific Missions of Discovery

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There is an interest in examining the Heliopause region (edge of Solar System) by the Heliophysics community. This need is well documented in the recent decadal survey.

Past scientific missions that have entered this region are Voyagers 1 & 2 but their outbound trip time was on the order of 35 years. There is much interest in developing revolutionary propulsion techniques that will enable such Heliopause scientific missions to be completed within 10 to 15 years, or quicker of the launch date.

One such enabling propulsion technique employs charged multiple (10 to 100) bare wire tethers that extend radially outward from a spinning spacecraft. Around the positively charged bare-wires a Debye Sheath is created. This sheath stands off of the bare wire at a sheath diameter that is proportional to the voltage in the wire and the location within the solar system. The protons that are expended from the sun (solar wind) bounce off of these bare wire sheaths and via the theory of momentum transfer, propulsive thrust is produced. The amount of thrust produced per unit mass is multiples in magnitude greater than the thrust produced by a solar sail. The electrons within the solar wind are also collected onto the wires and are removed from the spacecraft via an electron gun.

MSFC has done studies on this subject matter and is doing new studies on this propellant-less propulsion system as a recipient of a 2014 Phase I NASA Innovative Advanced Concepts (NIAC) award. This paper will show that this technology shall enable a scientific spacecraft the ability to reach the Heliopause within a 10 to 15 year time period. This will enable scientists and researchers to actually live long enough to see the fruits of the scientific instruments developed by them and their peers.